Vicia johannis and Wild Relatives of the Faba Bean: A Taxonomic Study[1]

A. N. E. Birch,[2,3] M. T. Tithecott,[2] and F. A. Bisby[2]

*A preliminary taxonomic and agronomic investigation was made of close relatives of the faba bean (*Vicia faba*) to aid future plant breeding. Cluster analysis of 2 yr's morphometric data showed that* V. johannis *is clearly separable from other members of the* V. narbonensis *complex. Also* V. faba *was much more distinct from either* V. narbonensis *or* V. johannis *than they are from each other. Petal colours at anthesis provided a rapid method of field identification for* V. faba, V. narbonensis, *and* V. johannis. *The 2 varieties of* V. johannis *can also be distinguished by their petal colours: var.* procumbens *shows a marked colour change at anthesis and var.* johannis *does not. The geographical distribution of the plant material studied suggests that* V. johannis *is found in Turkey and Europe despite being omitted from the major published floras. Both* V. johannis *and* V. narbonensis *possess agronomically useful characters of importance to faba bean breeders, including increased frost tolerance and resistance to both* Aphis fabae *and* Botrytis fabae.

There is currently much interest not only in the faba bean (*Vicia faba* L.), but also in associated wild and cultivated plants of the species in *Vicia* section Faba. Some authors envisage the possibility of locating an ancestor for the faba bean among these associated plants, and others hope to find a source of germplasm for wide crosses in faba bean breeding (Zohary, 1977; Cubero, 1982). The associated plants, however, are poorly known and there are confusing differences in the classifications used for them in various taxonomic treatments. As a consequence materials that might be of use to breeders are named in different ways, or are sometimes misidentified, and breeders are uncertain in using the taxonomy to help decide with which plants to experiment.

In preliminary studies we have found that one of the contentious species can be clearly distinguished among experimentally grown specimens, that some of its members show an interesting colour change in the flowers at anthesis, and that these plants may be worth investigating for other characters of agronomic potential.

CURRENT TAXONOMY

The genus *Vicia* currently contains 150 species (Allkin et al., 1983) divided by Kupicha (1976) into 2 subgenera: Vicia, with 5 sections including section Faba; and Vicilla, with 17 sections plus a further section added by Kupicha (1981).

The section Faba as recognised by Kupicha has long been known as a distinctive grouping that started as the genus *Faba* by Miller (1754). It was made a section of *Vicia* by Ledebour (1842) and maintained as such by Ascherson and Graebner (1909) and to the present with the recent addition of *Vicia bithynica* (L.) L., *V.*

---

[1] Received 20 March 1984; accepted 24 September 1984.

[2] Biology Department, Building 44, University, Southampton SO9 5NH, U.K.

[3] Present address: Scottish Crop Research Institute, Dundee, DD2 5DA, Scotland, UK.

Economic Botany, 39(2), 1985, pp. 177–190

galilaea Plitm. & Zoh., and *V. hyaeniscyamus* Mouterde. Section Faba is distinguished from other sections by the presence of a nectariferous spot on the stipules, a sub-regular calyx, parallel sutures of the legume, leaflets few (1–3 pairs) and usually longer than 2 cm, and lateral veins of leaflets not prominent, curving towards the apex (Kupicha, 1976). However some authors have excluded *V. bithynica* (its slender habit, presence of well-developed tendrils and long peduncles are rather different from the other species) and a few have persisted in the notion of *Vicia faba* being a monotypic genus *Faba* Miller, distinguished by the possession of an inflated pod with spongy partitions between seeds and the lack of tendrils.

As defined by Kupicha the section Faba contains 2 species that are clearly distinct, *V. faba* and *V. bithynica,* plus the *V. narbonensis*-complex, consisting of *V. narbonensis* L. and 4 similar forms sometimes recognised as distinct species. It is with this complex that we are concerned here: these taxa are of interest to agronomists and plant breeders as crop plants in their own right and as possible ancestors and/or sources of germplasm for *Vicia faba* breeding.

The present difficulties over the correct identification and nomenclature for plants in this complex arise partly because of the genuine conflict between 2 recently proposed classifications (Plitmann, 1967, 1970; Schäfer, 1973) and partly because of the widespread use, at least amongst English-speaking botanists, of *Flora Europaea* and *Flora of Turkey* neither of which gives the coverage and depth of the less accessible papers by Plitmann (with parts in Hebrew) and Schäfer (in German) (Table 1).

Ball (1968), in *Flora Europaea,* lists a single species, *V. narbonensis* L. *Vicia serratifolia* Jacq. is explicitly included and consequently the broad description includes plants with entire and serrate leaflets, 1–6 flowered racemes, 4–8 seeds per legume and both brown and black seeds. There is no reference, however, to the European plants placed in *V. johannis* Tam. by Schäfer, and the description makes no allowance for their whitish-yellow petals with violet veins and the distinctive violet or brown spot at the tip of the wing petals. We assume that it was not intended to include such plants, but it is possible that they were included but their petal colorations overlooked in surveys of herbarium material.

Plitmann (1967) also includes *V. serratifolia* in *V. narbonensis,* arguing that the serrate leaflets are of sporadic occurrence in mixed populations, and that serrations may occur on occasion in upper leaves or in lower leaves. He discusses the problem of plants with pale whitish or yellowish flowers and pilose pods, which he thinks of as transitional forms. "Transitional forms with *V. galilaea* and with *V. hyaeniscyamus*" are discussed under *V. narbonensis* in Plitmann (1967) and "transitional forms with *V. narbonensis*" under *V. galilaea* in Plitmann (1970). He lists *V. galilaea* and *V. hyaeniscyamus* as separate species (Plitmann, 1967), although subsequently doubts have been expressed as to the distinctness of *V. galilaea* (Plitmann, 1970) and *V. hyaeniscyamus* (Ladizinsky, 1975b). Ladizinsky writes under *V. hyaeniscyamus,* "Plants . . . with smaller and green stipules were repeatedly found in Israel, and were treated as *V. galilaea* ssp. *faboidea* (Plitmann, 1965). In the Israeli material, variation in stipule size and color do exist. Though the extreme type described in Mouterde (1961) has not been found, I tend to treat that material as *V. hyaeniscyamus.*"

Schäfer (1973) bases her classification primarily on the results of hybridisation experiments but includes accurate descriptions of the materials used. She recog-

TABLE 1. COMPARISON OF *Vicia* CLASSIFICATIONS BY BALL, PLITMANN AND SCHÄFER.

Schäfer, 1973	Plitmann, 1970, in *Flora of Turkey*		Plitmann, 1967		Ball, 1968, in *Flora Europaea*
V. narbonensis	var. *narbonensis*	*V. narbonensis*	var. *narbonensis*	*V. narbonensis*	*V. narbonensis* (including *V. serratifolia*)
V. serratifolia	var. *serratifolia*		var. *serratifolia*		
V. johannis	"transitional forms"	*V. galilaea*	"transitional forms"		not included (see text)
V. galilaea			*V. galilaea*		not in Europe
V. hyaeniscyamus	not in Turkey		*V. hyaeniscyamus*		not in Europe

TABLE 2. CHARACTER SETS A AND B.

	Character	Character states (set A)	Character states (set B)
1	Plant ht. at first pod set:	≤55 cm, >55 cm	ht. to nearest 5 cm
2	Max. no. flowers per inflorescence at anthesis:	1, 2, 3, 4	1, 2, 3, 4, 5, 6, 7, 8
3	Lgest flower length at anthesis:	≤2.2 mm, >2.2 mm	size in mm
4	Background colour of standard petal front at anthesis:	cream, violet, deep purple	white, yellow, purple
5	Vein colour of standard at anthesis:	brown, brown/purple, purple	white, violet, brown, contrasted brown and purple, yellow/brown
6	No. contrasting veins on standard:	few, moderate, v. many	N.R.
7	Wing spot at anthesis:	present, absent	present violet, present brown, present black, absent
8	Peduncle length at anthesis:	absent, <4 mm, 4–10 mm	size in mm
9	Pedicel length at anthesis:	N.R.[a]	size in mm
10	No. points on stipule:	≤6, >6	1, 2, 3+
11	Stipule abaxial nectary:	absent, present nonpigmented, present pigmented	pigmented, nonpigmented
12	Colour of stipules:	N.R.	green, violet
13	Calyx nectary:	absent, present minute, present large	N.R.
14	Calyx teeth:	N.R.	glabrous at margin, pubescent at margin
15	Max. no. leaflets per leaf at any node:	4, 5, 6	2, 3, 4, 5, 6, 7, 8
16	Leaf type:	N.R.	tendrillous, mucronate
17	Leaflet margin:	entire, slight serration only in upper leaves, pronounced and in most leaves	entire, some serrate or dentate
18	Leaflet length:	N.R.	size in mm
19	Leaflet width:	<300 mm, 300–400 mm	size in mm
20	Leaflet length/width ratio:	1.40–1.55, 1.56–1.75, 1.76–2.00	N.R.
21	Leaflet upper surface texture:	soft and waxy, slightly hispid, hispid	N.R.
22	Leaflet upper surface luster:	N.R.	shiny, dull
23	Leaflet upper surface pubescence:	N.R.	glabrous, short hairs present
24	Leaflet margin:	sparsely pubescent, highly pubescent	glabrous, sparsely pubescent, highly pubescent
25	Stem pubescence:	N.R.	pubescent, glabrous
26	Legume c.s.:	N.R.	compressed, round
27	Mature legume length:	<59 mm, 59–70 mm	size in mm
28	Max. seed no. per legume:	4, 5, 6, 7, 8	max. no.
29	Max. legume no. per plant:	<13, 13–25	N.R.
30	Legume altitude at maturity:	erect, patent, pendant	N.R.

TABLE 2. CONTINUED.

	Character	Character states (set A)	Character states (set B)
31	Legume sutures:	N.R.	glabrous, ciliate with hairs ≤1 mm, ciliate with hairs >1 mm
32	Legume sutures:	N.R.	smooth, rough (dentate–tuberculate)
33	Seed colour:	N.R.	chestnut brown, brown, green/brown, black, dark brown, mixed
34	Seed length:	<6 mm, ≥6 mm	size in mm
35	Seed width:	N.R.	size in mm
36	Seed wt.:	N.R.	wt. in g
37	Seed Lilium strip colour:	N.R.	black, white, beige, brown, mixed brown and black, mixed white and beige
38	Seed lustre:	N.R.	shiny, dull
39	Hilum length (% of circumference)	N.R.	%
40	Plant habit:	1–3 branched decumbent, 3 branches some decumbent, 3 branches all decumbent	N.R.
41	Chocolate spot disease:	present, absent	N.R.
42	Aphid susceptibility:	low, medium, high	N.R.
43	Maturity group:	bud stage, flowering, pod ripening, mature pods	N.R.

[a] N.R., not recorded.

nises *V. serratifolia* as a distinct species with serrations on the uppermost leaves, and distinguishes this from *V. narbonensis* var. *salmonea* (Mouterde) Schäfer in which serrate leaflets are also slightly crenate and are restricted to the lowermost leaves. The latter crosses freely with other *V. narbonensis* forms but does not cross with *V. serratifolia,* whereas other *V. narbonensis* showed sterility in crosses with *V. serratifolia.* She places the pale white or yellow-flowered forms with purple or brown wing-spots and pilose pods in a separate species *V. johannis.* She maintains *V. galilaea* and *V. hyaeniscyamus* as distinct species.

The different systems are tabulated in Table 1 from which one can see that principal disagreements concern: 1) whether to treat *V. serratifolia* as a species distinct from *V. narbonensis,* and 2) whether to treat *V. johannis* as a species distinct from *V. narbonensis.*

We report below on a preliminary taximetric study that supports the treatment of *V. johannis* as a distinct species and provides some data on the status of *V. serratifolia.* It is, however, based on a detailed examination of a small sample of plants; the questions cannot be finally settled until a much wider range of materials has been examined.

MATERIALS AND METHODS

Field trial aims

Two field trials were carried out in successive years. The 1980 trial was primarily designed to investigate the range of host plant resistance against the aphid pest

Aphis fabae in a collection of 28 *Vicia* accessions supplied as *V. narbonensis,* as well as making a preliminary assessment of other agronomically useful characters (e.g., resistance to *Botrytis fabae* and frost tolerance). A taxonomic interest in this plant material arose secondarily, after careful identification of field-grown plants revealed that (a) several accessions had been misidentified by the original seed collectors, and (b) the taxonomic literature on section Faba was often contradictory or confusing in nature.

The 1981 field trial was expressly designed to investigate the taxonomic problems highlighted by the trial of 1980. The aim was to make an assessment of section Faba on a wider range of material (selected accessions of *V. faba* and its close wild relatives) and also using an expanded and modified character set (set B, Table 2) for morphometric scoring, developed and revised after the results of 1980 morphometric analysis (character set A, Table 2) had been assessed.

Accessions

The 1980 trial included 28 accessions supplied by the International Center for Agricultural Research in Dry Areas, Syria, as *V. narbonensis,* together with a further 10 accessions of taxonomic or geographical interest (supplied as *V. johannis, V. serratifolia,* and *V. galilaea*), added to the trial after the initial taxonomic problems of species misidentification were appreciated. Accessions in the 1981 trial were selected to cover the taxonomic variation pattern as thoroughly as possible: *V. faba* accessions were introduced (2 broad bean cultivars, 1 horse bean cultivar, 1 tick bean cultivar and 1 accession of *V. faba* subsp. *paucijuga* Muratova). Ten additional *V. johannis* accessions (including var. *procumbens* Schäfer and var. *johannis*) and 1 additional *V. galilaea* accession were introduced. The many accessions of *V. narbonensis* from the Bequ'a Valley, Lebanon (which showed little morphological variation in 1980) were reduced in number in 1981. Due to limited seed supplies, several accessions of taxonomic interest in 1980 (e.g., *V. galilaea*) could not be included in 1981. Full details of the plant materials are given in Table 3.

Plot designs

In 1980, 38 accessions were randomised within 10 rows, each accession being replicated 5–10 times within the plot. This design reduced edaphic or climatic effects on agronomic characters under assessment in the first year. In 1981, 24 accessions were grown in blocks, each containing 12 plant replicates of a single accession. This design facilitated the detection of further characters that varied among accessions.

Treatments and site

Seeds were germinated at room temperature in sterile vermiculite, transferred to peat pots and grown in a cool greenhouse for 2–4 wk prior to transplanting into horizontal, open, uniform plots on well-drained, light loam with a stony top soil at the University of Southampton Botanic Gardens, Chilworth. Early growth of seedlings was encouraged by applying 'Growmore' liquid fertiliser and a second treatment of ammonium sulphate was applied at pod set to maximise seed yields. Weeds were controlled and plots watered regularly.

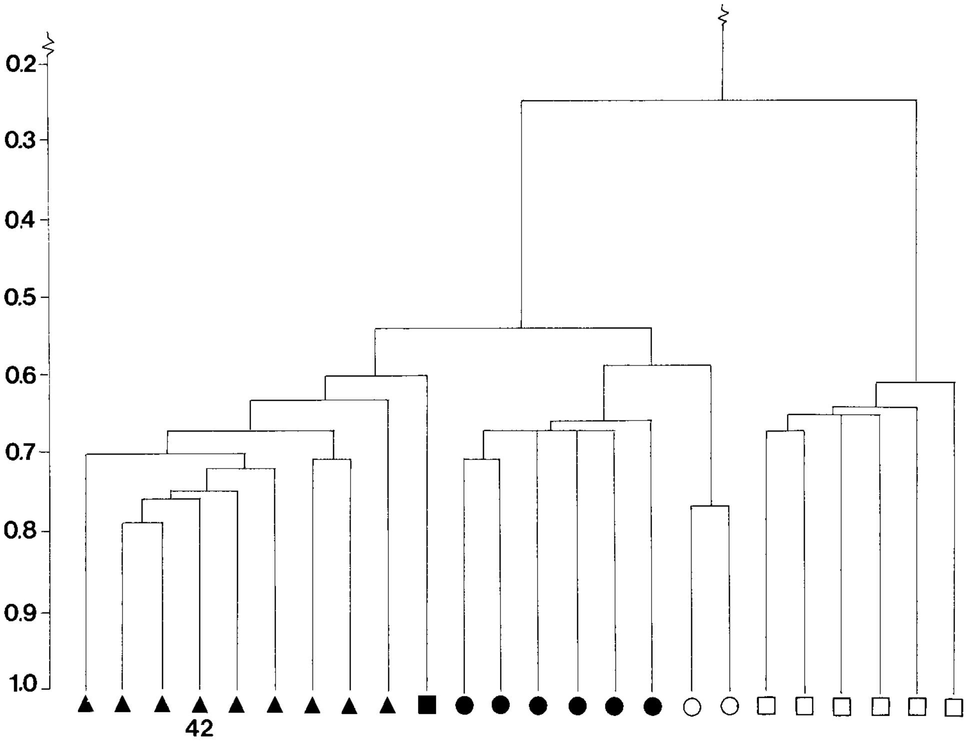

Fig. 1. Dendrogram of phenetic resemblances for *V. faba* □, *V. narbonensis* ●, *V. johannis* ▲, *V. serratifolia* ○ and *V. galilaea* ■ from sect. Faba using 1981 data. (Plant no. 42 received as *V. hyaeniscyamus.*)

Data collection

(a) Morphometrics and multivariate analysis.—Morphological comparisons were organised as a set of taxonomic characters with each character having a number of possible states or values. Character set A (9 binary and 15 matrix characters, Table 2) was used in 1980 and a more refined set B (12 binary, 2 multistates, 17 quantitative, 5 matrix, Table 2) in 1981. Each accession was scored for each character under as near as possible uniform conditions.

Morphometric data were analysed by the linkage diagram variant of single link cluster analysis using a mixed data similarity coefficient (Estabrook, 1966; Estabrook and Rogers, 1966). The single link method is preferred on theoretical grounds (Jardine and Sibson, 1971) and the linkage diagram variant is particularly suited to taxonomic work where outliers, chains of intermediates, and the internal structure of clusters are of particular interest (Bisby, 1973). The mixed data coefficient accommodates binary, ordered multistate and matrix characters in the calculation of an overall similarity value among accessions. For the matrix characters the user specifies the relative similarities of the various states of a character.

The results of this analysis can be summarised in a single dendrogram (Fig. 1), or given in more detail for a given similarity threshold in selected linkage diagrams (Fig. 2, 3). In the linkage diagrams, each accession is represented by a particular symbol, and the symbols are joined by lines to illustrate which are linked by

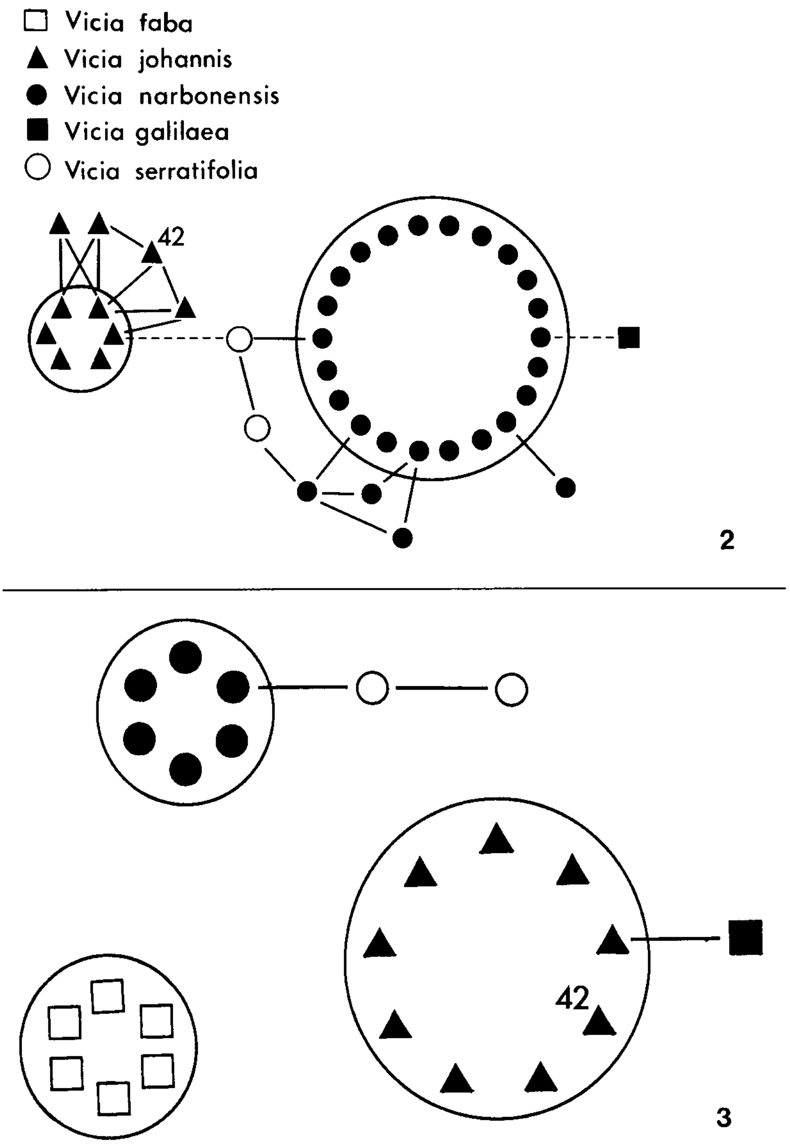

Fig. 2-3. Fig. 2. Selected linkage diagram from cluster analysis of 1980 data. Threshold similarities 0.77 (dotted line) and 0.78 (solid line), using character set A. Fig. 3. Selected linkage diagram from cluster analysis of 1981 data. Threshold similarity 0.58, using character set B.

similarities above a threshold level. Each group of linked symbols is known as a cluster, and at certain thresholds there may be a core of symbols so densely interconnected (using the criterion of having more than 3 links with other parts of the core) that to simplify the diagram they are drawn in a circle. The combination of symbols linked by lines, and others in a circle, gives an indication of the pattern of resemblances within a cluster. Outliers are represented as unconnected symbols, or those connected at the edge of a cluster, and intermediates appear as symbols joining 2 other sets of symbols together. The full series of linkage diagrams for many threshold values would be wasteful of space and tedious to examine. As in this example, it is usual to select for illustration purposes linkage diagrams for one or more threshold similarities, choosing diagrams for thresholds just higher than those at which major clusters fuse.

Floral pigment changes during anthesis and flower development were recorded for all accessions of *V. narbonensis* and *V. johannis* during both trials. Where possible, herbarium voucher specimens were kept after careful identification of field-grown material.

(b) Preliminary agronomic evaluation.—Resistance to *Aphis fabae* was assessed in 1980 on 29 verified accessions of *V. narbonensis* and 5 accessions of *V. johannis* (detailed results to be published separately). In both years, observations were made on the incidence of *Botrytis fabae*/*B. cinerea* and the frost tolerance of *V. narbonensis* and *V. johannis* compared to *V. faba* cultivars grown in adjacent plots.

RESULTS

1. Morphological comparisons

Results of single linkage cluster analyses are contained in a series of linkage diagrams. The most informative linkage diagram from analysis of the 1980 trial is given in Fig. 2 and that for the 1981 trial in Fig. 3.

(a) Both the 1980 and 1981 trials showed 2 clusters that were homogeneous and distinct. These corresponded to the species distinguished as *V. johannis* and *V. narbonensis* by Schäfer. In the 1980 trial the *V. johannis* cluster contained 6 accessions in a homogeneous core, with 4 outliers linked to them (similarity threshold 0.78, character set A, Table 2). In the 1981 trial, the *V. johannis* cluster contained 9 accessions in a homogeneous core (similarity threshold 0.58, character set B, Table 2), with one outlier, identified as *V. galilaea.* In 1980, the *V. narbonensis* cluster contained 22 accessions in its homogeneous core (similarity threshold 0.78, character set A, Table 2), with 7 outliers linked to them (4 accessions of *V. narbonensis,* 2 of *V. serratifolia* and one *V. galilaea*). In 1981, the *V. narbonensis* cluster contained a homogeneous core of 6 accessions (similarity threshold 0.58, character set B, Table 2), with 2 (*V. serratifolia*) outliers linked.

In the results of both trials, the 2 main clusters were robust, appearing at similarity thresholds of 0.83 and persisting until 0.77 (1980) and at 0.65 persisting until 0.54 (1981). The disparities in numbers of accessions in the clusters were caused by the different numbers of accessions used in the 2 trials and not by any misclassification of material.

(b) The 1981 results showed that the 6 *V. faba* accessions (including subsp. *paucijuga*) formed a homogeneous cluster distinct from the other accessions, at a threshold similarity of 0.58 (Fig. 3). The full series of linkage diagrams showed that *V. narbonensis* and *V. johannis* clusters joined each other at similarity threshold 0.54, but the combined cluster did not join the *V. faba* cluster until similarity threshold 0.25 (Fig. 3). This indicates that *V. faba* is much more distinct from either *V. narbonensis* or *V. johannis* (similarity threshold 0.25) than are *V. narbonensis* and *V. johannis* from each other (closest members have similarity threshold of 0.54). This result is in agreement with the seed protein electrophoresis results of Ladizinsky (1975a) in placing *V. faba* quite separate from the other species that form the *V. narbonensis* complex.

(c) Results for the 2 accessions with serrations on the uppermost leaves of mature plants are inconclusive, even though the same 2 accessions appear linked as a pair of outliers to the *V. narbonensis* cluster in both 1980 and 1981 (Fig. 2, 3). In 1980 the leaflet serration character (number 10 in Table 2) was scored with 3 states: *absent, slight* and *pronounced*; the fact that the *pronounced* state scored for these 2 accessions was poorly associated with other characters was shown by these 2 accessions appearing in the cluster analysis amongst other *V. narbonensis* outliers (Fig. 2). This character by itself was insufficient to characterise a grouping because the intermediate condition was common (41% of accessions), and its occurrence appeared dependent on the age of the plants. In the 1981 trial the leaflet serration character (number 15 in Table 2) was redefined with only 2 states: *entire* and *some leaflets serrate or dentate,* again with just these 2 accessions scored in the latter state. However, the second character set (Table 2) contained several additional characters, 3 of which have states that were associated with marked leaf serration: pods 6–7 seeded, seeds black, and centre strip of hilum beige. Thus in the 1981 analysis (Fig. 1, 2) these 2 accessions formed a separate cluster at similarity coefficient 0.77, persisting until 0.58, when the *V. serratifolia* cluster links with *V. narbonensis.* This incomplete evidence tends to support Schäfer (1973), who considers *V. serratifolia* to be distinct from the related *V. narbonensis* primarily because the two do not cross freely. Schäfer's distribution map for *V. narbonensis* is incomplete, but despite this, *V. serratifolia* appears also to have a more northerly distribution with extensions into France, into Hungary and from Rumania to N. Caucasus.

(d) No conclusions could be drawn about the position of *V. galilaea* since only 2 (but different) accessions were grown and verified in 1980 and 1981. The single accession in 1980 was a plant with characters intermediate between *V. galilaea* and *V. narbonensis* whilst the single accession grown in 1981 appeared intermediate between *V. galilaea* and *V. johannis.* There was no evidence to support the suggestion (Yamamoto et al., 1982) that *V. galilaea* might be intermediate between the *V. narbonensis* complex and *V. faba.*

(e) A single accession obtained as the hyaena bean, *V. hyaeniscyamus,* did not bear the diagnostic "enormous blue-purple stipules" described by Mouterde (1961). The seed was collected in the Bequ'a Valley in Lebanon, 50 km east of, and hence outside, the species' supposedly limited distribution between Telkalakh (Syria) and Tripoli (Lebanon). In both 1980 and 1981 this accession bore flowers with a yellowish ground colour and a wing spot that turned brown, thus falling within the morphological range of *V. johannis* (plant No. 42 in Fig. 1, 2, 3). We therefore assumed that we had yet to obtain material of authentic *V. hyaeniscyamus.*

2. *Flower colour during anthesis*

(a) Diagnostic characters to differentiate among *V. faba, V. narbonensis,* and *V. johannis* in flower.—Our observations throughout the 2 flowering seasons showed that the background colour of the standard petal and the presence or absence of a wing spot in flowers that are fully open are important diagnostic characters. Plants with violet to deep purple background colouration of the standard and with

TABLE 3. DESCRIPTION OF COLOUR CHANGES IN PETALS OF *Vicia johannis* VAR. *procumbens*.

	Standard petal	Wing petal	
Flower stage	Background colour	Background colour	Spot colour
Bud	Violet to purple	Off-white	Violet to purple
Opening	Pale yellow, violet veins, violet patch	Off-white	Deep purple
Fully open	Pale yellow, veins turning brown, violet patch	Off-white	Turning rich brown
Withered	Pale brown	Pale brown	Dark brown, remaining distinct

wings of the same colour and lacking a distinct spot belong to *V. narbonensis* or the serrate-leaved form referred to by Schäfer as *V. serratifolia.* In contrast, *V. johannis* plants have a cream to yellow background colour to the standard and wings with veins and wing spots that are violet or brown. The *V. faba* forms included had white background standard colour and black wing spots but there are other forms in which the white background is suffused with purple, and 'Triple White' forms that lack the wing spot. In the accessions examined these pigmentation characters correlated exactly with the other taxonomic characters and should therefore provide a quick method of field identification.

(b) Description of flower colour changes useful in the identification of *V. johannis* varieties.—Immature flowers of *V. johannis* are pale whitish colour with some violet veins, and with a distinctive intense violet spot at the tip of the wing petal. In *V. johannis* var. *procumbens* there is a rapid colour change at anthesis in which the whitish background colour turns pale yellow, and the intense violet wing spot turns to a rich brown. This colour change probably explains the confusing descriptions of flower colours and occasional mention of yellow-flowered forms found in the literature. The colour change is absent in var. *johannis.*

The colour changes are tabulated for *V. johannis* var. *procumbens* in Table 3. They were obtained both by field observations and by examining colour transparencies of whole and dissected flowers photographed against a neutral grey background with reference colour scales.

3. Geographical distribution

We have reliable details of the wild origin for only a fraction of the accessions studied, and the origins given in Table 4 should be treated with caution. However, the countries of origin for accessions identified as *V. johannis* are of interest and are given below. They support the conclusion from Schäfer's maps that *V. johannis* occurs in both the *Flora of Turkey* area and the *Flora Europaea* area. The opinion that many of the *V. johannis* plants from Turkey referred to by Schäfer are the same plants as those referred to as transitional forms by Plitmann is corroborated by herbarium specimens annotated by both at Kew. Lebanon, 3 accessions, wild origin; Turkey, 5 accessions, wild origin; Uzbekistan, USSR, 1 accession, wild origin; Crimea, USSR, 2 accessions, wild origin; Rumania, 1 accession, uncertain origin; Portugal, 1 accession, uncertain origin. With the exception of 3 accessions

TABLE 4. PLANT MATERIAL STUDIED, BY EXPERIMENTAL NO. AND VERIFIED NAME, INCLUDING ACCESSION NO. (FOR REFERENCE TO VICIEAE SEED COLLECTION, SOUTHAMPTON), ORIGIN (WITH SUPPLIER'S NO. WHERE AVAILABLE), WILD LOCALITY, AND VOUCHER SPECIMEN NO.

1 *Vicia faba* var. *faba* cv. The Sutton, Sutton's Seed Torquay, Devon.
2 *V. faba* var. *faba* cv. Masterpiece Green Longpod, 820000, Hurst Seeds Witham, *Tithecott 3,* SPN.
3 *V. faba* var. *equina* cv. Cockfield, 820001, R.H.M. Seeds Dunmow Essex, *Tithecott 11,* SPN.
4 *V. faba* var. *minor* cv. Danas, 820002, National Seed Development Organisation Ltd. Newton Cambs., *Tithecott 12,* SPN.
5 *V. faba* subsp. *paucijuga,* 800106, ICARDA Syria No. 172, *Tithecott 25,* SPN.
6 *V. narbonensis,* 790164, Univ. Ankara Faculty of Agriculture, Turkey, *Tithecott 26 & Macfarlane 422,* SPN.
7 *V. narbonensis,* 800248, ICARDA Syria No. NEW v1, Bequ'a Valley, Lebanon, *Otto 30,* SPN.
8 *V. narbonensis,* 800251, ICARDA Syria No. NEW v4, Bequ'a Valley, Lebanon.
9 *V. narbonensis,* 800252, ICARDA Syria No. NEW v5, Bequ'a Valley, Lebanon.
10 *V. narbonensis,* 800253, ICARDA Syria No. NEW v6, Bequ'a Valley, Lebanon.
11 *V. narbonensis,* 800255, ICARDA Syria No. NEW v8, Bequ'a Valley, Lebanon.
12 *V. narbonensis,* 800256, ICARDA Syria No. NEW v9, Bequ'a Valley, Lebanon.
13 *V. narbonensis,* 800257, ICARDA Syria No. NEW v10, Bequ'a Valley, Lebanon.
14 *V. narbonensis,* 800258, ICARDA Syria No. NEW v11, Bequ'a Valley, Lebanon.
15 *V. narbonensis,* 800259, ICARDA Syria No. NEW v12, Bequ'a Valley, Lebanon.
16 *V. narbonensis,* 800260, ICARDA Syria No. NEW v13, Bequ'a Valley, Lebanon, *Otto 31,* SPN.
17 *V. narbonensis,* 800261, ICARDA Syria No. NEW v14, Bequ'a Valley, Lebanon.
18 *V. narbonensis,* 800263, ICARDA Syria No. NEW v16, Bequ'a Valley, Lebanon.
19 *V. narbonensis,* 800267, ICARDA Syria No. NEW v20, Bequ'a Valley, Lebanon, *Tithecott 24 & 25,* SPN.
20 *V. narbonensis,* 800268, ICARDA Syria No. NEW v21, Bequ'a Valley, Lebanon.
21 *V. narbonensis,* 800269, ICARDA Syria No. NEW v22, Bequ'a Valley, Lebanon.
22 *V. narbonensis,* 800270, ICARDA Syria No. NEW v23, Bequ'a Valley, Lebanon.
23 *V. narbonensis,* 800271, ICARDA Syria No. NEW v24, Bequ'a Valley, Lebanon.
24 *V. narbonensis,* 800272, ICARDA Syria No. NEW v25, Bequ'a Valley, Lebanon.
25 *V. narbonensis,* 800273, ICARDA Syria No. NEW v26, Bequ'a Valley, Lebanon.
26 *V. narbonensis,* 800274, ICARDA Syria No. NEW v27, Bequ'a Valley, Lebanon.
27 *V. narbonensis,* 800282, ICARDA Syria No. NEW v36, Afghanistan, *Macfarlane 503,* SPN.
28 *V. narbonensis,* 800284, ICARDA Syria No. NEW v38, Jel Alum Aleppo, Syria, *Otto 32,* SPN.
29 *V. narbonensis,* 800285, ICARDA Syria No. NEW v39, Hama, Syria.
30 *V. narbonensis,* 808288, USDA Beltsville, Turkey.
31 *V. serratifolia,*[a] 808289, USDA Beltsville, Malta, *Tithecott 2 & Otto 21,* SPN.
32 *V. serratifolia,*[a] 808290, USDA Beltsville, Coimbra B.G., Portugal, *Tithecott 2 & Otto 21,* SPN.
33 *V. johannis* var. *procumbens,* 780823, Iasi B.G., Rumania No. 412.
34 *V. johannis* var. *procumbens,* 790162, Coimbra B.G., Portugal.
35 *V. johannis* var. *procumbens,* 790348, Jalta B.G., USSR No. 683, Crimea, USSR.
36 *V. johannis* var. *procumbens,* 800275, ICARDA Syria No. NEW v28, Bequ'a Valley, Lebanon.
37 *V. johannis* var. *procumbens,* 800276, ICARDA Syria No. NEW v 29, Bequ'a Valley, Lebanon.
38 *V. johannis* var. *procumbens,* 800277, ICARDA Syria No. NEW v31, Mardin Province, Turkey, *Tithecott 8,* SPN.
39 *V. johannis* var. *procumbens,* 800278, ICARDA Syria No. NEW v32, Tohat Province, Turkey, *Tithecott 17 & Macfarlane 502,* SPN.
40 *V. johannis* var. *procumbens,* 800279, ICARDA Syria No. NEW, v33, Turkey, *Tithecott 15 and Macfarlane 555,* SPN.
41 *V. johannis* var. *procumbens,* 800280, ICARDA Syria No. v34, Turkey, *Tithecott 9 & Macfarlane 551,* SPN.
42 *V. johannis* var. *procumbens,* 800281, ICARDA Syria No. NEW v35, Lebanon, *Tithecott 14 & Otto* 20, SPN.
43 *V. johannis* var. *procumbens,* 800393, ICARDA Gatersleben, E. Germany No. NAR 521179, Crimea, USSR (Jalta B.G., USSR), *Tithecott 1, 18, 19, 20,* SPN.

TABLE 4. CONTINUED.

44	*V. johannis* var. *johannis,* 800390, Gatersleben, E. Germany No. NAR 51176.
45	*V. johannis* var. *johannis,* 800391, Gatersleben, E. Germany No. NAR 48177, Kemalpasa Izmir, Turkey.
46	*V. galilaea,*[a] 790512, Coimbra B.G., Portugal, *Bisby 1233,* SPN.
47	*V. galilaea,*[a] PB. 4, Plant Breeding Institute, Cambridge.

[a] Provisional identification.

obtained via Gatersleben and one labelled *V. hyaeniscyamus,* all the above accessions arrived labelled as *V. narbonensis.*

4. Agronomic potential

During field trials in 1980 and 1981, the following useful plant characters were recorded for *V. narbonensis* and *V. johannis*: (i) Both species, especially *V. johannis,* were more resistant to the black bean aphid, *Aphis fabae,* than *V. faba* cultivars grown in adjacent plots (Birch, in press), (ii) Resistance against chocolate-spot disease (*Botrytis fabae* and *B. cinerea*) was considerably higher in both *V. johannis* and *V. narbonensis* compared to adjacent *V. faba* cultivars, and (iii) Both *V. johannis* and *V. narbonensis* showed a high level of winter hardiness when overwintered under local conditions. This is in accord with a report (Elci, 1975) that *V. narbonensis* is an invaluable winter crop in Turkey, surviving temperatures as low as −30°C.

Although these data are preliminary and agronomic trials should be repeated under a range of growing conditions, these results indicate that both *V. narbonensis* and *V. johannis* possess several agronomic characters of interest to plant breeders, either for introduction into *V. faba,* or to develop these wild or semicultivated species into crops for marginal areas.

CONCLUSIONS

(i) Preliminary morphometric assessment supports the view that *V. johannis* is distinct from *V. narbonensis,* (ii) *V. johannis* subsp. *procumbens* shows a distinctive flower-colour change, (iii) *V. johannis* occurs within the *Flora of Turkey* and *Flora Europaea* areas, and (iv) *V. johannis* and *V. narbonensis* have characteristics of potential agronomic use.

ACKNOWLEDGMENTS

We are grateful to Bob Allkin, Gavin Ramsay, Nigel Maxted and Barbara Pickersgill for their invaluable criticism of the manuscript, to Barbara Otto and Alistair Rivers for much help in nurturing the plants, and to Steve Wratten, Nazmul Haq and Raymond Cornick for help with the randomised plot. We thank the Agriculture and Food Research Council for a research grant and the many institutions and individuals listed in Table 3 for the gift of seed.

LITERATURE CITED

Allkin, R., T. D. Macfarlane, R. J. White, F. A. Bisby, and M. E. Adey. 1983. List of species and subspecies in the Vicieae: issue 2. Vicieae Database Project Publication No. 1, Southampton, U.K.

Ascherson, P. F. A., and C. O. Graebner. 1909. *Vicia. In* Synopsis der mitteleuropaischen Flora, Vol. 6, p. 902–995. Engelmann, Leipzig.

Ball, P. W. 1968. *Vicia. In* T. G. Tutin, V. H. Heywood, N. A. Burges, D. M. Moore, D. H. Valentine, S. M. Walters, and D. A. Webb, ed, Flora Europaea, Vol. 2, p. 129–136. Cambridge Univ. Press.

Birch, A. N. E. In press. Field evaluation of resistance to Black Bean Aphid, *Aphis fabae,* in close relatives of the Faba Bean, *Vicia faba.* Ann. Appl. Biol.

Bisby, F. A. 1973. The role of taximetrics in Angiosperm taxonomy. I. Empirical comparisons of methods using *Crotalaria.* New Phytol. 72: 699–726.

Cubero, J. I. 1982. Interspecific hybridization in *Vicia. In* G. Hawtin and C. Webb, ed, Faba Bean Improvement, p. 91–108. Martinus Nijhoff, The Hague.

Elci, S. 1975. Gida Tarim ve Hayvancilik Bakaanligi Ziraat Isleri Genel Murdurlugu Yayvinlari D-167 (*Vicia* vetches), 20–27. Cag das Basimevi, Ankara, Turkey.

Estabrook, G. F. 1966. A mathematical model in graph theory for biological classification. J. Theoret. Biol. 12: 297–310.

———, and D. J. Rogers. 1966. A general method of taxonomic description for a computed similarity measure. BioScience 16: 789.

Jardine, N., and R. Sibson. 1971. Mathematical Taxonomy. Wiley, London.

Kupicha, F. K. 1976. The infrageneric structure of *Vicia.* Notes Roy. Bot. Gard. Edinburgh 34: 287–326.

———. 1981. Tribe 21. Vicieae (Adans.) DC. (1825), nom. conserv. prop. *In* R. M. Polhill and P. H. Raven, ed, Advances in Legume Systematics, p. 377–381. Royal Botanic Gardens, Kew.

Ladizinsky, G. 1975a. Seed protein electrophoresis of the wild species of section Faba of *Vicia.* Euphytica 24: 785–788.

———. 1975b. On the origin of the broad bean, *Vicia faba* L. Israel J. Bot. 24: 80–88.

Ledebour, C. F. von. 1843. Flora Rossica. Vol. 1, part 3, p. 664. Schweizerbart, Stuttgart.

Miller, P. 1754. The Gardeners Dictionary. 4th ed. Rivington, London.

Mouterde, P. 1961. Contribution a l'étude de la flore syrienne et libanaise (suite). Bull. Soc. Bot. France 108: 310–316.

Plitmann, U. 1965. Three new legumes from Israel. Israel J. Bot. 14: 90–96.

———. 1967. Biosystematical Study in the Annual Species of *Vicia* of the Middle East. Hebrew Univ., Jerusalem.

———. 1970. Annual *Vicia. In* P. H. Davis, ed, Flora of Turkey, Vol. 3, p. 274–325. Edinburgh University Press.

Schäfer, H. I. 1973. Zur Taxonomie der *Vicia narbonensis* Gruppe. Kulturpflanze 21: 211–273.

Yamamoto, K., O. Moritani, and A. Ando. 1982. Karyotypic and isozymatic polymorphism in species of the section *Faba* (genus *Vicia*). Tech. Bull. Fac. Agric. Kagawa Univ. 34: 1–12.

Zohary, D. 1977. Comments on the origin of cultivated broad bean, *Vicia faba* L. Israel J. Bot. 26: 39–40.